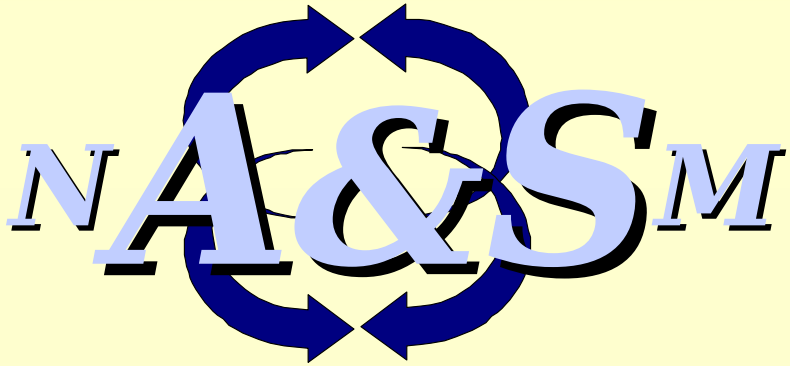
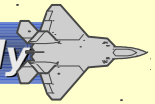
# JSIMS
# Air and Space (A&S)
# Development Agent




## Civil Environment

# Civil Environment

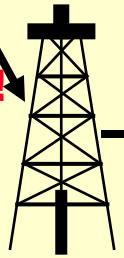




BATTLESPACE | MATHEMATICS | BATTLESPACE

SNE | CE Engine | BSEs

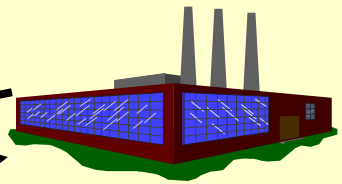
STRIKE!

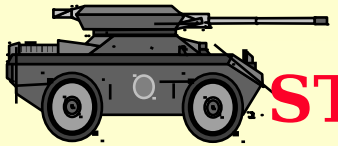


Damage

Input-Output Model and Linear Problem Solver (LPS)

REDUCED POWER





STOP

NO SORTIES

Regions, Commodities, Initial config.

DATA: Targets, Capacities, etc.

Operator Terminal

# Major CE Capabilities



- **Monitor Physical Damage Effects**
  **Production, Storage and Transportation Assets**
- **Model Cascading Effects**
- **Adaptive behavior (Technology Substitution)**
- **All Sides represented including resources well beyond the playbox**
- **Repair capability**
- **Model critical friendly resources that must be protected**

# Dynamic BSE Interfaces



- **Capacity effects:**
  - **CE subscribes to damage attribute of civil infrastructure: power generation, POL production, storage, highways, bridges, tunnels, airfields, rails, dams, communications**
  - **CE monitors production status**
- **BSE specifies commodity needs to CE**
- **CE outputs commodity production to BSE**
- **BSE reacts to commodity limits**

# Input-Output Economic Model



## I/O Economics Example -

**The production of 1 unit of output of**

**- POL requires 0.2 units of transportation, 0.4 units of chemicals, and 0.1 unit of itself**

**- Munitions requires 0.1 units of POL, 0.1 unit of munitions, 0.15 units of transportation, and 0.3 units of chemicals**

**- Transportation requires 0.6 units of POL, 0.1 unit of itself, and 0.25 units of chemicals**

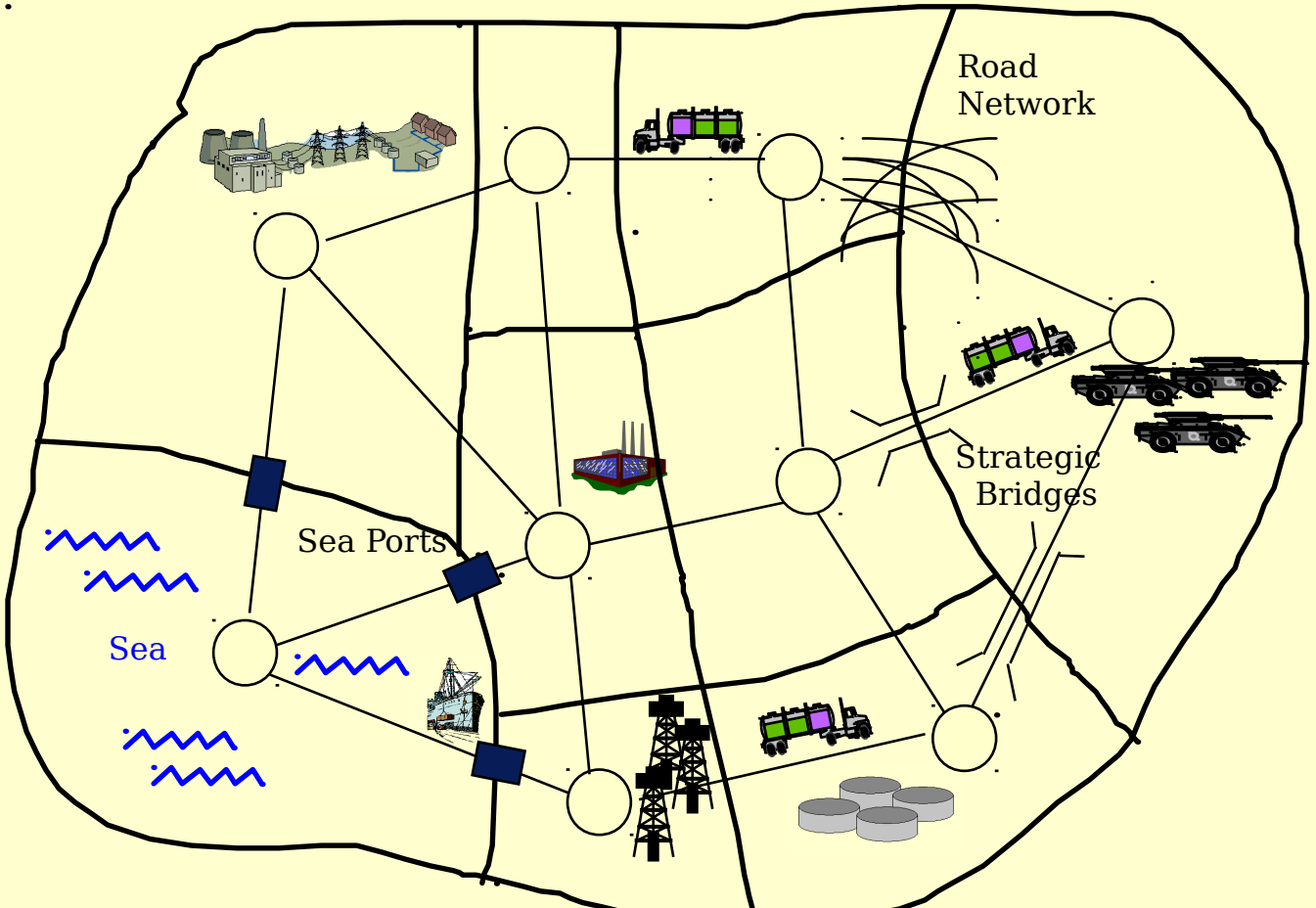
**- Chemicals requires 0.3 units of POL, 0.3 units of transportation, and 0.2 units of itself**

| | POL | Munitions | Transport | Chemicals |
|---|---|---|---|---|
| POL | 0.1 | 0.1 | 0.6 | 0.3 |
| Munitions | 0.0 | 0.1 | 0.0 | 0.1 |
| Transport | 0.2 | 0.15 | 0.1 | 0.3 |
| Chemicals | 0.4 | 0.3 | 0.25 | 0.2 |

Transport and Chemicals are intermediate commodities and are not delivered.

# CE Breaks Map into Subregions



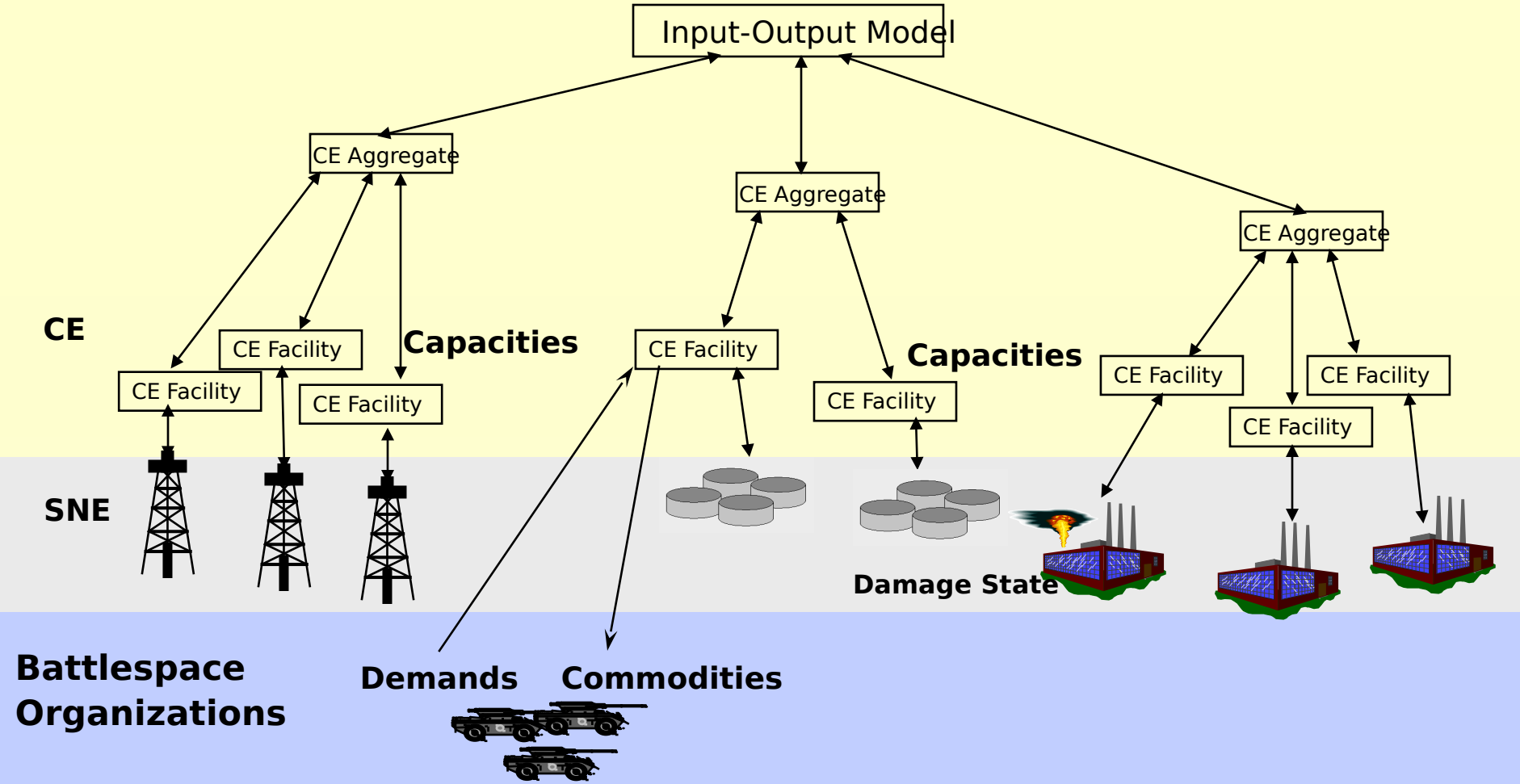



**Production, Storage and Transportation Modeled by Subregion to Model Movement of Commodities**

# Key Components

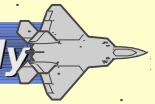
## Resource Aggregation - CE Interfaces





# DEMONSTRATION OF THE CORE CE MODEL





1 - **Initialization** - Facilities (Production, Storage and Transportation), Subregions and Input-Output Matrix

2 - **Facility Damage** - Reduces production capability

3 - **Demand for Commodity by BSE** - Multiple levels

4 - **Import** - Increases Stockpile

5 - **Subregions Capacities Destroyed**

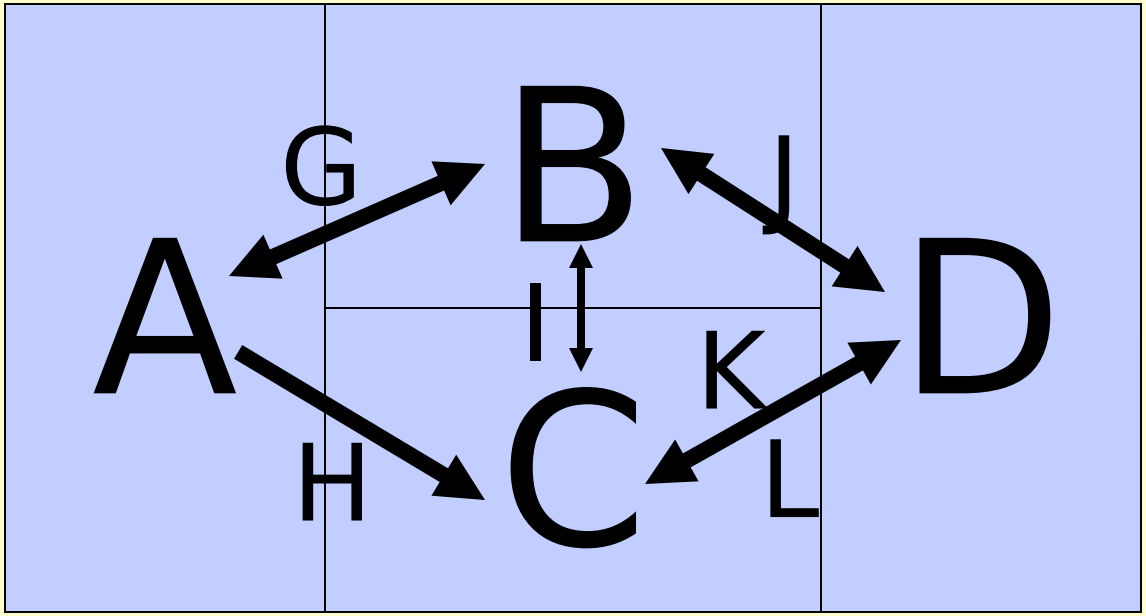
6 - **BSE is Deprived of Commodity** - BSEs behaviors must be altered if it has no fuel. (This is modeled by the BSE)

7 - **Demand Override by Controller**

8 - **Repair Facilities** - Capacities Restored

# Initialization
## Fuel Subregions






- **Fuel Subregions A, B, C & D**
- **Transportation Subregions G, H, I, J, K & L**

**Note: H is unidirectional and K and L are two independent routes between C and D**

# Initialization

## Intermediate Demand Matrix

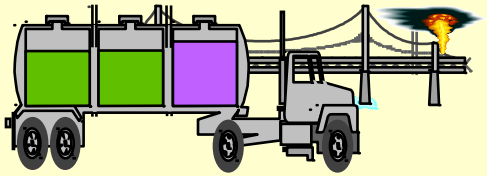


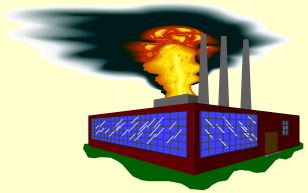
| USED FROM | | | Produced | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | G | H | I | J | K | L | M |
| | | | FUE | FUE | FUE | FUE | AMM | AMM | TRA | TRA | TRA | TRA | TRA | TRA | TRA |
| | A | FUE | 0.01 | 1.00 | 1.00 | 0.00 | 0.03 | 0.00 | 10.00 | 14.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | B | FUE | 1.00 | 0.01 | 0.00 | 1.00 | 0.02 | 0.02 | 15.00 | 0.00 | 6.00 | 7.00 | 0.00 | 0.00 | 0.00 |
| | C | FUE | 1.00 | 1.00 | 0.01 | 1.00 | 0.01 | 0.01 | 0.00 | 11.00 | 9.00 | 0.00 | 14.00 | 0.00 | 0.00 |
| | D | FUE | 0.00 | 1.00 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 12.00 | 13.00 | 0.00 | 0.00 |
| | E | AMM | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | F | AMM | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | G | TRA | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | H | TRA | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | I | TRA | 0.00 | 0.05 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | J | TRA | 0.00 | 0.08 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | K | TRA | 0.00 | 0.00 | 0.20 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | L | TRA | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | M | TRA | 0.00 | 0.00 | 0.06 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Facility Damage



- **Facility Damage Reduces Capacity**
  - **Damage to Production, Storage and Transportation**
  - **Small levels of damage**
    - **LP Solver does not need to run**
  - **Large levels of damage**
    - **LP Solver must run to determine the effects of damage**

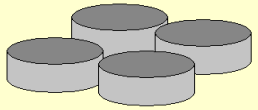


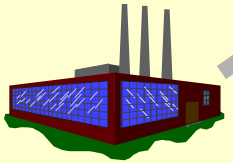


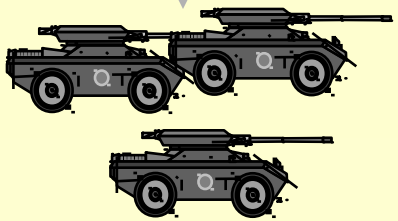
# Demand for Fuel



- **Demand for Fuel from available Stockpile**
  - **Unit requests Fuel from CE**
  - **CE satisfies demand from available stockpiles**
    - **LP Solver does not need to run**
- **Demand for Fuel that exceeds available Stockpile**
  - **Unit requests Fuel from CE**
  - **CE cannot satisfy demand from available stockpiles**
    - **CE runs the LP Solver to determine if it has the resources available to satisfy demand**



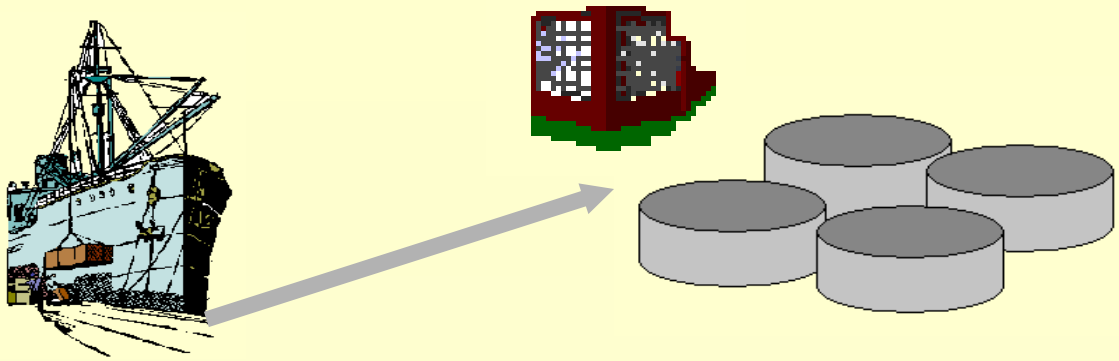




# Import



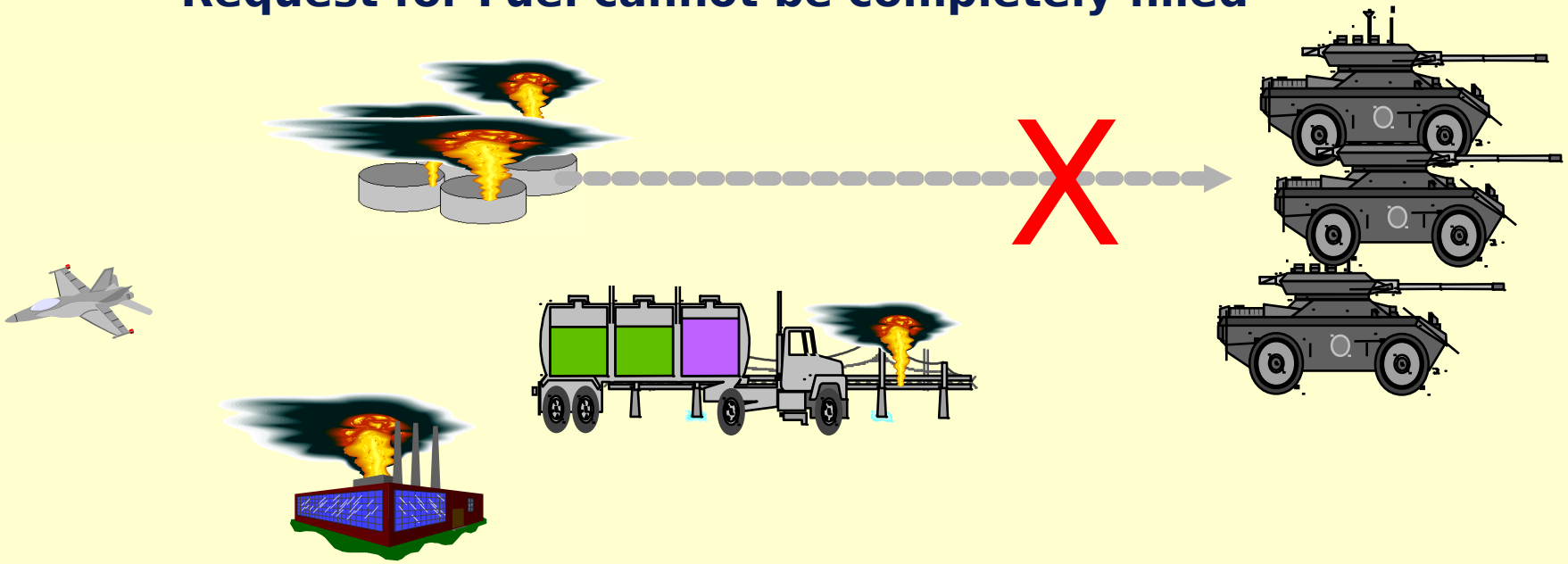
- **Import is Delivered to a CE Storage Facility**
  - **Stockpile increase by the Imports**



# Subregions Capacity Completely Destroyed



- **Subregions Damage Eliminates Capacity**
  - **Damage to All Production, Storage and Transportation**
  - **Request for Fuel cannot be completely filled**



# Demand Override

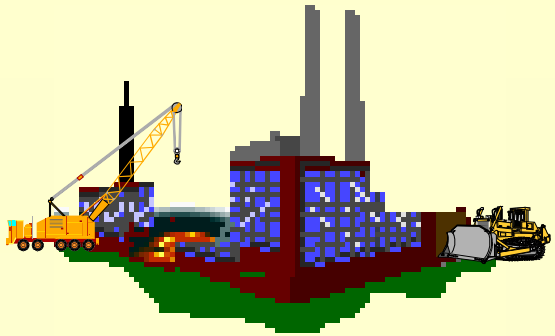


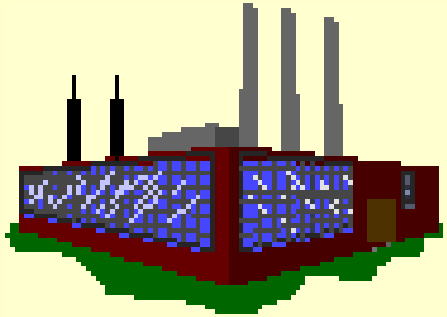
- **Damage to Fuel Production cause Problems with Game Objectives**
  - **Controller Overrides the CE Model**
    - **Subregion Gets All the Fuel It Needs**

# Repair



- **Production Facility is Restored to Full Capacity Due to BSE Repair**



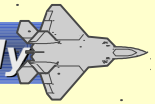


**BSE or SNE Repairs Damage**

**CE Model Responds by Restoring Capacity**

# Capabilities of Future Builds





- **Build 2 - Integrate with Other DA's**
  - -- SNE Damage
  - -- A&S Airbase - POL, Munitions, Repair Parts
  - -- Joint Organizations - Elec. Power, POL, Food, Water
  - -- Increase Size and Resolution of Database

- **Build 3/IOC - Full Interface to all effected BSEs.**
  - -- POL, Munitions, Repair Parts, Electric Power, Civilian Communication,
    Food, Water, Clothing
  - -- Multisided model for SW Asia
  - -- MIDB data
  - -- Controller LCA tool
    - Easy entry of Initialization data and consistency checking
    - 2 D Display map